Small Probes for Orbital Return of Experiments Mission Design

Completed Technology Project (2011 - 2015)

Project Introduction

Currently the Georgia Tech Small Probes for Orbital Return of Experiments (SPORE) team is collaborating with Aurora Flight Sciences to provide a launch, re-entry, and recovery platform for a range of biological, thermal protection system flight characterization, and material science experiments. The platform will accommodate polar low earth orbit (LEO), geosynchronous transfer orbit (GTO), and ISS-return missions to maximize the science potential. In addition to progressing science, a primary goal of the SPORE team is to identify possible commercial payloads in order to increase accessibility to space. Ultimately SPORE provides a testbed to advance technologies and scientific knowledge required for future human and robotic explorations and the opportunity to increase commercialization in space. With a small design team, each team member is intimately involved in all aspects of the design process. However, my focus concerns the SPORE mission design, specifically modeling the orbital trajectory and maneuvers for the ISS, LEO, and GTO missions. In addition to the orbit trajectory, a re-entry architecture will be designed that meets the requirements set by the range of payloads, orbits, and entry vehicle sizes inherent in the SPORE mission concept. The selected entry, descent, and landing (EDL) architecture will be validated and modeled using 3-DOF and 6-DOF software. Analysis will be completed on this architecture to assess landing footprint and error sources. Results from the landing dispersion analysis will confirm current landing site selections and help establish recovery procedures. SPORE's unique mission concept lends itself to a broad EDL design space and requires the development of a new method to compare different entry architectures and choose the optimal design. The proposed optimization method involves the Georgia Tech Planetary Entry Systems Synthesis Tool (PESST). PESST computes performance sensitivities across wide range of EDL design parameters so that the user can assess risk and performance margins. Ultimately PESST helps narrow the broad EDL design space to a few architectures that meet mission requirements. Although PESST provides high level entry modeling including down range, velocity, and acceleration approximations, models of higher fidelity such as Program to Optimize Simulated Trajectories II will be used to ensure the strict payload requirements are met as well as validate the results from PESST. Working with PESST and higher fidelity software to select and model SPORE EDL architecture advances architecture analyses as well as entry simulation and modeling identified in the Space Technology Roadmaps and Technology Area Breakdown Structure.

Anticipated Benefits

SPORE's unique mission concept lends itself to a broad EDL design space and requires the development of a new method to compare different entry architectures and choose the optimal design. This optimization method involves the Georgia Tech Planetary Entry Systems Synthesis Tool (PESST). PESST computes performance sensitivities across wide range of EDL design

Project Image Small Probes for Orbital Return of Experiments Mission Design

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Organizational Responsibility

Responsible Mission Directorate:

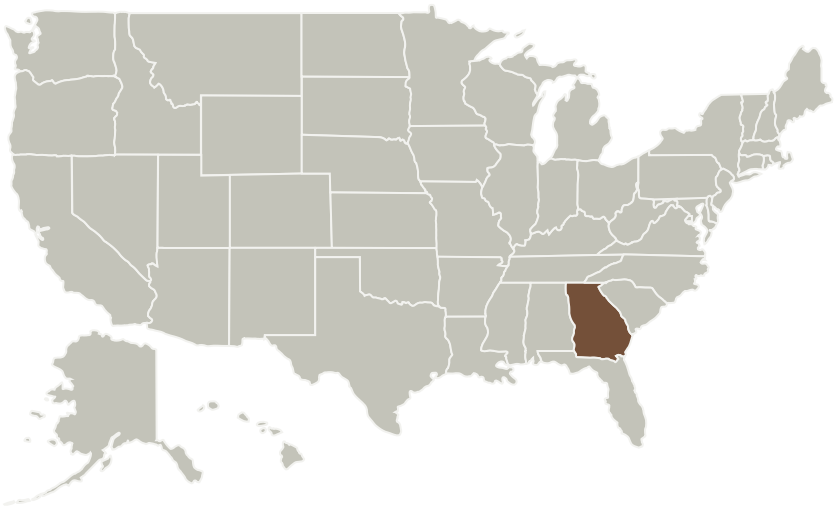
Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

parameters so that the user can assess risk and performance margins.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Georgia Institute of Technology-Main Campus(GA Tech)	Supporting Organization	Academia	Atlanta, Georgia

Primary U.S. Work Locations
Georgia

Project Management

Program Director:
Claudia M Meyer

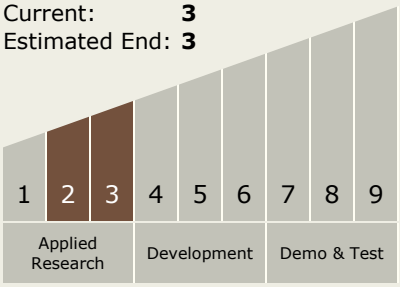
Program Manager:
Hung D Nguyen

Principal Investigator:
David A Spencer

Co-Investigator:
Nicole Bauer

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.1 Architecture Design and Analysis

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Images

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Project Image Small Probes for Orbital Return of Experiments Mission Design
(https://techport.nasa.gov/image/1844)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html